



platform solutions

on-line news for the hardware developer

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Feature Story

Each month we'll provide a feature article on key industry trends and developments. Authored by a member of Intel's Executive Staff, you'll find insightful and useful information for product development, planning and execution.

Top News Stories

Delivering an in-depth report on key platforms, products and technologies, our Top Stories provide a monthly source of information on the issues affecting hardware developers. Be sure to check in every month for the latest stories that are driving the evolution of the industry.

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Every month we cover the latest developments in platform initiatives and technologies. Our "Platforms" pages provide news on the latest trends and initiatives for the business, home, mobile, server and workstation platforms. Our "Industry Events" page keeps you up to date on upcoming industry gatherings targeted at the platform and peripheral developer, including the new Intel Developer Forum.

Technology News

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On behalf of all of us at Platform Solutions, welcome to the future of the PC platform!

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Feature

Reshaping the Industry

By Pat Gelsinger
Corporate Vice President and General Manager
Business Platforms Group, Intel Corporation

Imagine a designer at work at a high-end mechanical CAD workstation, reshaping a realistically shaded and textured solid model of a high-performance sub-assembly, and then instantly re-integrating the component back into the overall design.

The Intel® Pentium® II Xeon™ processor is literally reshaping the workstation industry by delivering breakthrough performance to a new segment of the market—midrange and higher workstations for technical computing. What is even more significant for the industry is that record-setting performance is being delivered with the unique price-performance benefits of Intel Architecture building blocks. It is no wonder that the Pentium II Xeon processor has already received unprecedented industry support.

Powered by the new Pentium II Xeon processor, the Intel Architecture platform is breaking new ground in such performance-intensive application areas as mechanical design automation, digital content creation and 3D animation, electronic design automation, and financial modeling and analysis. In each of these areas, the Pentium II Xeon processor-based workstation delivers a combination of breakthrough performance, outstanding value, and ultimate flexibility.

Performance

Based on the proven performance of the P6 microarchitecture in the processor core, the Pentium II Xeon processor at 400 MHz is available with 512 KB or 1 MB of Level-2 cache, a full-speed (400-MHz) cache bus, and features a 100-MHz multi-transaction system bus. At the introduction of the processor in June, Intel announced that a Pentium II Xeon processor-based workstation established record-setting performance in the Pro/ENGINEER Bench98 evaluation, completing the test faster than leading proprietary RISC-based workstations (http://www.intel.com/businesscomputing/wrkstn/b_proeng.htm). The performance gains extend to other real-world applications. At Intel's Application Solution Centers, Pentium II Xeon processor-based workstations have achieved an average five-fold performance improvement over 46 leading workstation applications running on proprietary-based workstations. In addition, to match performance with application load, Intel Pentium II Xeon platforms are designed to scale to dual-processor performance, without significantly adding to system cost.

Value

Intel Architecture not only brings superior performance to the midrange and higher workstation market segment, it also brings industry-leading value. The same Intel Architecture workstation that set the Pro/ENGINEER benchmark record carries an estimated street price of \$7,500. By comparison, next-best performing proprietary workstations are priced at \$20,795 and \$20,809, respectively. Pentium II Xeon processor-based workstations also deliver long-term value by accelerating multithreaded applications. The ability to simultaneously and quickly perform frame design and rendering (shading and texturing) in multithreaded 3D applications can save valuable operator time—and money.

Flexibility

The availability of Pentium II Xeon processor-based platforms in the workstation space provides an attractive option for IT managers. IT managers have the option of consolidating the most demanding workstation applications and Windows NT*-based productivity applications on a single platform. Dual-processor platform configurations support flexible multitasking, so users can run their productivity and technical apps simultaneously on a single, manageable platform.

During the announcement of the Pentium II Xeon processor, application vendors presented a series of “knock your socks off” workstation demos—from mechanical CAD to 3D graphics animation—that

showcased some of the hundreds of applications that run on high-performance Intel Architecture workstations.

The shape of things to come

In the months ahead, the Pentium II Xeon processor will demonstrate something equally dramatic—the ability to reshape an entire industry with a family of Intel processors that provides a clear roadmap to the future of technical computing. Start with this issue of *Platform Solutions*. Then check back regularly for announcements as Intel delivers continuous performance improvements, together with high-volume economy of scale. For high-performance workstations, Intel Architecture is the shape of things to come.

About the Author:

Pat Gelsinger is Corporate Vice President and General Manager of Intel Corporation's Business Platform Group. Pat is responsible for Intel's business computers including PCs, network computers, NetPCs, workstations, and data security solutions for personal computers.

For More Information:

Be sure to read the Top Stories in this month's issue of *PSN*:

The Foundation for a New Class of Workstations, by Dr. Dileep Bhandarkar—

<http://developer.intel.com/solutions/issue/focus.htm>

Intel Architecture Workstation Q&A with Anand Chandrasekher—

<http://developer.intel.com/solutions/issue/stories/top1.htm>

New Performance Horizons extending the Intel® Architecture, by Tom Macdonald—

<http://developer.intel.com/solutions/issue/stories/top2.htm>

PC 99: Evolving Beyond ISA, by Carol Jacobson—

<http://developer.intel.com/solutions/issue/stories/top3.htm>

Born to Serve: A Tale of Technologies, by Rafael Maymi—

<http://developer.intel.com/solutions/issue/stories/top4.htm>

Pentium® Processor Modules Enable Embedded Designs, by Bob Baraga—

<http://developer.intel.com/solutions/issue/stories/top5.htm>

Focus

The Foundation for a New Class of Workstations

By Dr. Dileep Bhandarkar
Director of Architecture
Workstation Products Division, Intel Corporation

The arrival of Intel® Architecture in the mid-range workstation market segment has revolutionary implications for the industry. The Intel Pentium® II Xeon™ processor not only delivers industry-leading performance on many workstation applications, it also provides excellent scaling for multitasking and multithreading environments through cost-effective high-performance dual processing. In short, workstations based on the Pentium II Xeon processor represent a new value proposition for the industry.

Advantages of the Pentium II Xeon processor

Workstations based on the Pentium II Xeon processor offer several key advantages:

- Intel Architecture platforms are widely available from multiple OEMs worldwide.
- Pentium II Xeon processor systems provide the highest performance available on key industry benchmarks.
- The Pentium II Xeon processor is designed for cost-effective scalability to high-performance dual-processor workstations.
- Intel Architecture workstations run both technical computing applications and desktop applications on the same system using Windows NT*.

Dual-processor performance

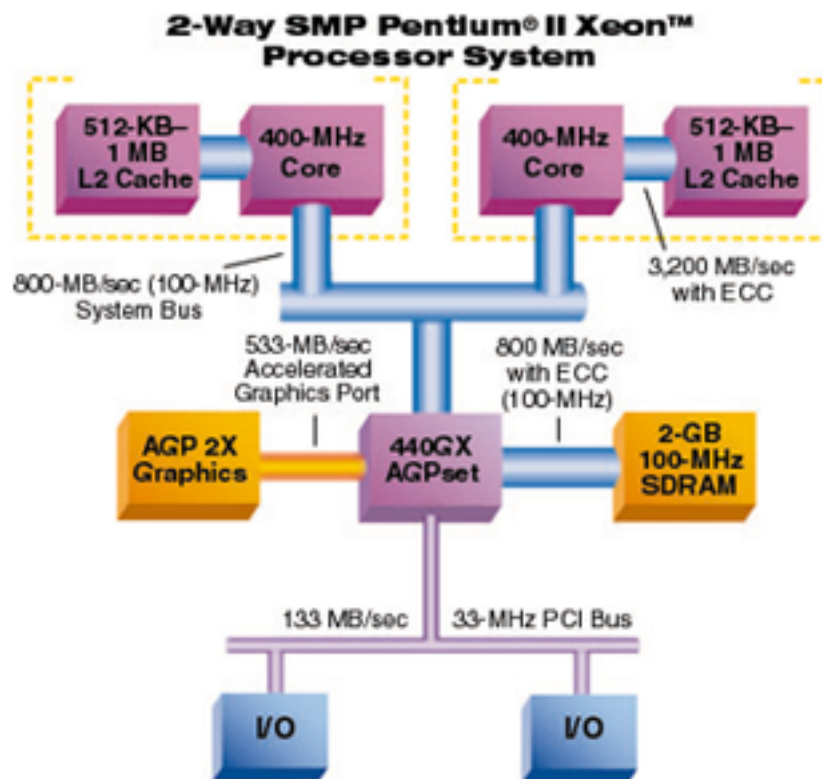
The ability to add a second Pentium II Xeon processor while only adding approximately 15 percent to overall system cost allows OEMs to deliver workstations equal to the demands of a variety of complex multitasking and multithreaded application workloads. Benchmark results show that adding a second Pentium II Xeon processor to a workstation can improve system performance as much as 90 percent for complex and compute-intensive tasks.

- **Multiprocessing** is important when a user runs multiple single-threaded applications simultaneously. Dual-processor configurations allow software compilations to run in the background on one processor, while users can work with Windows-based productivity applications on the second processor in the foreground. Similarly, engineering simulation or analysis can be run while interactive design work is being done. Visual content can be developed while a complex image is being rendered.
- **Multithreaded applications** can provide significant performance gains in mechanical engineering (MCAE) and electronic (ECAD) design, image processing, video editing, and financial modeling.

System architecture at-a-glance

Intel Architecture workstations incorporate these key features:

- Proven .25μ "P6 microarchitecture" core with dynamic execution, running at 400 MHz
- Dual Independent Bus (D.I.B.) architecture, that allows cache accesses to occur independent of system bus activity
- Full-speed 400-MHz L2 cache bus, providing the equivalent of 3,200 MB/sec of instruction and data throughput to the core processor
- Large 512-KB and 1-MB error-correcting (ECC) L2 cache memory options, providing scalability matched to application requirements
- 100-MHz multi-transaction system bus for inter-processor and I/O communication, pipelined to enable simultaneous transactions and providing peak bandwidth of up to 800 MB/sec
- Intel's unique split-transaction system bus, allowing processors to efficiently share the bus, while improving overall bus utilization
- Intel 440GX AGPset, with support for AGP 2x and up to 2 GB of 100-MHz SDRAM memory



Key Architectural Features of Multiprocessor Workstations Built on the
Intel® Pentium® II Xeon™ Processor and Supporting Chipsets

Symmetric multiprocessing

Dual-processor Pentium II Xeon processor workstations support Symmetric Multiprocessing (SMP). This architecture treats multiple processors as equals, improving application performance by allowing any processor to do the work of the other and allowing multithreaded applications to run concurrently on all available processors.

Dynamic execution

Dynamic execution implements a high level of concurrency within the processor itself, removing the traditional constraints of linear instruction sequencing between fetch and execute phases of execution. Dynamic execution has three major elements that enable the Pentium II Xeon processor to streamline and predict the order of software instructions:

- **Multiple branch prediction** uses an algorithm to anticipate jumps in instruction flow to predict where the next instructions can be found in memory with extremely high accuracy.
- **Data flow analysis** improves efficiency by optimizing the scheduling of instructions to be executed, independent of the original program order.
- **Speculative execution** looks ahead of the program counter, predicts program branches, and executes instructions that are likely to be needed.

Software flexibility, hardware manageability

Intel Architecture in a midrange workstation allows flexible integration of Windows NT-based productivity applications with workstation applications on a single platform.

Hardware-based system manageability features include an integrated thermal sensor and Error Checking and Correction (ECC). In addition, the processor's System Management Bus (SMBus) enables efficient communications between the processor thermal sensor, processor-specific Processor Information ROM (PIROM), OEM-writable EEPROM, and the rest of the system.

The foundation for a new class of workstations

Intel Architecture has arrived in the midrange and higher workstation segments. Workstations based on the Intel Pentium II Xeon processor not only deliver industry-leading performance for technical computing applications, they also enable OEMs to offer a powerful new value proposition to their customers. Equally important for the industry, the Pentium II Xeon processor provides a clear roadmap to further enhancements in IA-32 performance.

Widespread availability

According to International Data Corporation, Intel Architecture workstations showed a 59 percent compounded annual unit growth rate from 1995 to 1997, while unit shipments of non-Intel Architecture workstations actually declined by 5 percent.

What is driving this market segment penetration? The price-performance advantages of Intel Architecture play a key role. Systems based on the Pentium II Xeon processor can deliver performance competitive with proprietary workstations for one-third to one-half the price. Such price-performance advantages are one reason that the Pentium II Xeon processor is supported by the industry's leading workstation manufacturers.

In conclusion

For the first time, an Intel Architecture platform can meet the needs of the most demanding multitasking and multithreaded applications in technical computing, engineering, graphics, and financial analysis.

Workstation users should start evaluating the performance and cost benefits of using Intel Architecture-based workstations in the midrange and higher segments of the workstation markets.

About the Author:

Dileep Bhandarkar is Director of Architecture for Intel's Workstation Products Division. Dileep is responsible for defining requirements of Intel Architecture Workstations and for workstation performance activities.

For More Information:

Visit the Intel developer Web site for a detailed presentation of the architecture of the Intel Pentium II Xeon processor and information for platform developers.

The following white papers are also available:

- Architectural Support (<http://www.intel.com/businesscomputing/wrkstn/pdf/archsupport.pdf>) for Multiprocessing on Pentium II Xeon Processor Based Workstations provides an overview of IA-32 for midrange workstation platforms.
- Breakthrough Workstation Performance with the Intel Pentium II Xeon Processor (<http://www.intel.com/businesscomputing/wrkstn/pdf/breakthrough.pdf>) includes performance benchmark results and detailed references.
- Cost/Performance Benefits of Multi-Tasking on Intel Architecture Multiprocessor Workstations (<http://www.intel.com/businesscomputing/wrkstn/pdf/mtask.pdf>) provides a formula useful for calculating payback.
- Multi-Threading: Taking Advantage of Intel Architecture Multiprocessor Workstations (<http://www.intel.com/businesscomputing/wrkstn/pdf/mthread.pdf>) provides useful information for software developers.

Top Stories

Intel Architecture Workstation Q&A with Anand Chandrasekher

Intel has taken the workstation industry to new heights in 1998. With the June introduction of the Intel® Pentium® II Xeon™ processor, Intel offers workstation users uncompromising performance at a competitive price. Platform Solutions News recently caught up with Anand Chandrasekher, General Manager of Intel's Workstation Products Division, to expand on Intel's leadership role in the workstation industry. Here are some excerpts from that conversation.

Q. First of all, how does a workstation differ from a desktop PC?

A. The difference between a workstation and a PC is driven by usage model. A PC is an all-purpose, utility, desktop tool used primarily for business computing functions. A workstation, on the other hand, is involved in *creating* product and monitoring product consumption. A PC can have a 400-MHz Intel Pentium II processor, performance graphics, 64 MB of memory and memory addressability up to 512 MB. Meanwhile, a workstation can have a 400-MHz Intel Pentium II Xeon processor specifically optimized for high-end systems, high-performance 2D and 3D graphics, gobs of standard memory and memory addressability up to 2 GB. Think of a workstation as a sports car optimized for performance, while a PC is a car you use every day to drive to work.

Q. Indeed, the Intel Pentium II Xeon processor that Intel introduced in June is specifically designed for high-end workstation and server systems. How do Intel Pentium II Xeon processor-based workstations compare to traditional RISC-based workstation systems?

A. The Intel Pentium II Xeon processor is purely optimized for workstation and server applications, and it is designed for scalability. For example, with an Intel Pentium II Xeon processor-based workstation, you can use a workstation application to design a mountain bike, which is a pretty complex product, or you can use the same application to design an automobile. Designing an automobile is obviously a much more complex task, but the Intel Pentium II Xeon processor, with its full-speed backside cache of 400 MHz, is optimized to scale seamlessly in performance with the application regardless of the task. Using the race car analogy, the Intel Pentium II Xeon processor, allows workstation users the performance to design a mountain bike, or step on the gas without a performance "bottleneck" and design something as complex as an automobile.

The difference between Intel Pentium II Xeon processor-based workstations and traditional RISC-based workstations is two-fold: 1) Intel Pentium II Xeon processor-based workstations offer outstanding performance, better than RISC-based workstations; and 2) Intel Pentium II Xeon processor-based workstations are a fantastic value compared to RISC-based systems. So what you're getting for the first time with Intel Pentium II Xeon processor-based workstations is not just price/performance, but pure performance as well. This changes the industry landscape substantially.

Q. Will Intel Pentium II Xeon processor-based workstations replace Intel Pentium II processor-based workstations in the marketplace?

A. No, the two are targeted at different market segments and will coexist. The workstation market has various market segments based on performance and price characteristics. The Intel Pentium II Xeon processor is optimized for customers who desire pure performance and scalability, while Intel Pentium II processor-based workstations are ideal for customers who want price performance and great value.

Q. Intel has announced that it is scheduled to introduce the high-performance Merced processor with 64-bit architecture for workstation and server systems in the year 2000. Should workstation users seeking performance wait for the Merced processor?

A. Absolutely not. Intel's Merced processor will boost performance levels to the next generation and provide some unique characteristics that will enable us to deliver "bar none" performance to the industry, but workstation users should not wait if they are seeking high levels of performance today. The Intel Pentium II Xeon processor offers uncompromising performance and outstanding value to workstation users.

Q. Many workstation users today operate both a workstation and a PC in their office environment. They need their workstation to create product and their PC to run office applications. How does the Intel Pentium II Xeon processor help bridge the gap between workstations and PCs, so workstation users only need one system?

A. This is the advantage of having a workstation based on Intel Architecture. It is undeniable in the corporate environment that the PC rules, and total cost of ownership (TCO) has been a buzz word in the industry for the last several years. In the effort to reign in manageability costs and create a seamless IT (information technology) structure, having unique architectures in your office environment doesn't drive a lower TCO. If anything, it makes it worse. But with Intel Pentium II Xeon processor-based workstations, you can not only run your workstation applications, but you can also operate desktop applications on the same platform. That's the power of Intel architecture-based workstations—you can unify your workstation and desktop operations. That's a clear economy, and the big gain is productivity improvement.

About the Author:

Anand Chandrasekher is General Manager of Intel's Workstation Products Division, which is responsible for development of Intel Architecture workstations and technologies.

For More Information:

See the focus article in this issue for workstation related information:

The Foundation for a New Class of Workstations, by Dr. Dileep Bhandarkar—

<http://developer.intel.com/solutions/issue/focus.htm>

For the latest news on workstations on a continuing basis, read the monthly Workstation Platform page in this newsletter—

<http://developer.intel.com/solutions/platfms/workstat.htm>

And don't forget to check out the Workstation Products Home site too—

<http://developer.intel.com/design/wrkstn/index.htm>

New Performance Horizons Extending the Intel® Architecture

By Tom Macdonald
Director of Marketing
Intel Enterprise Server Group

Consistent with Intel's strategy to design and deliver unique processor products targeted for specific market segments, the new Pentium II Xeon processor features technical innovations designed specifically for servers running demanding business applications such as ERP, corporate data warehousing and decision support, and electronic commerce. Used in combination with Intel's new 450NX chipset, the Pentium II Xeon processor provides OEMs and IHVs with an ideal solution for developing value 4-way servers, performance 4-way servers, and 8-way and higher systems using clustering technology.

New Features Provide Performance and Price/Performance Improvements

As the first in a new family of branded processors designed for high-performance enterprise computing, the Pentium II Xeon processor is based on the same P6 microarchitecture at the heart of Intel's Pentium II processors. Intel has equipped the Pentium II Xeon processor and its companion chipset with additional capabilities that challenge proprietary systems at all levels of the enterprise while paving the way for new levels of performance for midrange and higher servers. As such, Intel's newest processor is uniquely positioned as a common, compatible solution designed to meet the needs of today's rapidly evolving enterprise server marketplace.

The Pentium II Xeon processor has been designed to balance processor performance with the memory and I/O architecture of enterprise servers, helping to eliminate bottlenecks while improving system scalability. The first member of the Pentium II Xeon processor family runs at 400 MHz, and is available with either a 1-MB or 512-KB L2 cache and a 100-MHz system bus. The processor also provides addressable memory support of up to 64 GB. And the Intel 450NX PCIsset—optimized for servers with four or more processors—provides up to 8 GB of memory support using the Intel Extended Server Memory Architecture, and offers multiple 32-bit and 64-bit PCI buses.

Systems based on the Pentium II Xeon processor can be configured to scale to four or eight processors and beyond, enabling them to deliver the performance and features of comparable proprietary systems—but at nearly half the price. In addition, systems incorporating the Pentium II Xeon processors will integrate seamlessly into business infrastructures with the aid of the processor's System Management bus (SMBus) capabilities, as well as other advanced features designed to enhance overall platform manageability.

A Roadmap for the Future

The 400-MHz Pentium II Xeon processor is the first entry in a new family of branded processors that will extend the performance of the 32-bit Intel Architecture to encompass the range of today's and tomorrow's enterprise and technical computing. Intel plans to introduce a second Pentium II Xeon processor running at 450 MHz—with 2-MB, 1-MB, and 512-KB L2 cache versions—during the second half of 1998.

Another milestone scheduled for early 1999 is the availability of 8-way standard high-volume (SHV) servers based on the Pentium II Xeon processor and Intel's forthcoming Profusion™ chipset. This introduction will bring the benefits of flexible systems to businesses that require higher performance than that provided by 4-way solutions. In addition, Intel plans to offer the manageability, scalability, and performance advantages of the Pentium II Xeon processor in low-cost, 2-way server solutions in early 1999.

A Unifying Architecture for Every Market Segment

The introduction of the Pentium II Xeon processor is the latest example of Intel's clearly defined strategy to develop optimized products to meet the needs of all segments of today's expanding computer marketplace. This includes entry level, mainstream and high-performance desktop PCs, mobile computers, advanced workstations, and SHV to data center servers. As a result, the 32-bit Intel



architecture today encompasses multiple operating environments and thousands of ISV solutions—all of which translate into increased flexibility for businesses of all sizes.

The industry's leading enterprise server and workstation OEMs have announced plans to introduce midrange and higher systems based on the new Pentium II Xeon processor. A number of advanced workstations will be available throughout the summer of 1998, while the first SHV servers based on the processor are slated for introduction before the end of Q3 1998. For IHVs and OEMs alike, the time has come to take advantage of the price/performance and enhanced features of the Pentium II Xeon processor—Intel's latest innovation designed to advance the frontiers of enterprise computing.

About the Author:

Tom Macdonald is the director of marketing for the Intel Enterprise Server Group, where he is responsible for product marketing and planning, business strategy and messaging, and Intel's enabling efforts to promote the Intel Architecture in the server marketplace.

For More Information:

Check out the Server Solutions Web site for:

General Pentium II Xeon processor server information—

<http://www.intel.com/procs/servers/xeon/index.htm>

Pentium II Xeon processor server benchmark information—

<http://www.intel.com/procs/servers/xeon/benchmarks/index.htm>

PC 99: Evolving Beyond ISA

By Carol Jacobson
PC 99 Program Manager and System Design Guide Co-Editor
Intel Corporation

Many scientists believe that the extinction of the dinosaurs involved a catastrophic impact event of global proportions. The next big step in the evolution of the PC—the extinction of ISA (“Industry Standard Architecture”) slots in the PC platform—will also make an impact of global proportions. One difference is that this change has been carefully planned and will not be catastrophic for participants, thanks to the *PC 99 System Design Guide* co-authored by Intel and Microsoft.

While the industry is now engaged in PC 98 designs, PC 99 is coming fast. The time to prepare is now, and Intel can help. Version 1.0 of the *PC 99 System Design Guide* is now posted for industry review on the Intel (<http://developer.intel.com/design/desguide/>) and Microsoft PC 99 Web sites. Compliance with PC 99 should be achieved by the first quarter of 1999. As part of its role as co-author of PC 99, Intel is not only driving PC 99 hardware content, but is also working closely with the industry to enable the timely delivery of PC 99-compliant products in 1999.

End of the ISA legacy

Perhaps the most interesting aspect of PC 99 is its elimination of ISA option slots which have been a part of PC platform implementation since the early 1980's. ISA's low speed, connected protocol, lack of power management, and gluttony for critical system resources, position it as a poor team player in today's balanced system design. The *PC 98 System Design Guide* eliminated ISA devices and PC 99 spells the end of ISA option slots for adapter cards. In the future, devices that use COM and LPT—in addition to legacy devices such as mice and keyboards—will need to make the transition to Universal Serial Bus (USB) and the IEEE 1394 high-speed serial bus. The result will be improved usability, better PC performance, greater user satisfaction, and a dramatic reduction in ISA-related customer complaints and support calls.

Look to Intel for solutions

Since it provides a check-off for the continuing evolution of the PC platform, participation in the development of PC 99 is a responsibility that Intel takes very seriously. Intel has responded to the technical challenges by devoting content owners to each chapter of PC 99.

Intel is currently engaged in helping the PC industry review, understand, and provide feedback on PC 99 and continues to provide technical support to assist vendors implement PC 99-compliant products. For example, Intel's PC 99 chapter content owners worked closely with industry representatives at the April design review session held jointly with Microsoft in Portland, Oregon, which was attended by 200 industry participants.

PC 99 and industry initiatives

Intel is working within the industry to assure that PC 99 addresses the major PC platform initiatives, including Instantly Available PC, Wired for Management, USB, and Accelerated Graphics Port (AGP).

- Intel's Instantly Available PC initiative is fully consistent with the OnNow design initiative and provides guidelines for hardware design to ensure efficient power management on the desktop.
- With regard to Wired for Management, it is recognized that OEMs supply office PC systems to corporations with specific required features. For example, a customer might want to insert network adapters at an end-user site. An office PC system submitted for PC 99 compliance testing must include a network adapter. Including the network adapter with the PC system assists in remote new system setup. To meet the requirements, a vendor's implementation must be compatible with the technology defined in *Network PC System Design Guidelines, Version 1.0b* (<http://developer.intel.com/ial/wfm/design/bibliog.htm>).

- One possible implementation for remote new system setup for Intel® Architecture platforms is described in the *Wired for Management Baseline, Version 1.1a*.
<http://developer.intel.com/ial/wfm/design/bibliog.htm>

A few other highlights of PC 99

- Consumer PCs—if implemented, a modem must deliver 56 kbps throughput and be V.90-compliant.
- Office PCs—must have 64 MB of RAM, include a network adapter with a NDIS 5.0 driver, and support for new system setup.
- Mobile PCs—require a smart battery or ACPI control method battery.
- Workstations—require a minimum of 128 MB of RAM with ECC.
- Entertainment PCs—require 3D hardware acceleration with additional texture and performance capabilities, in addition to DVD-video and MPEG-2 playback.

Leading the way to PC 99

PC 99 will guide the industry in the development of PC platforms which will offer greater usability and more rewarding user experiences. In addition to playing a key role in the PC 99 guidelines, Intel continues to support the industry by providing the specialized knowledge needed to implement PC 99-compliant products.

Next steps

- You should gain familiarity with *PC 99 System Design Guide, Version 1.0* now available on the Intel PC 99 Web site, and begin your implementation plans.
- Plan to attend the Intel Developer Forum for in-depth presentations on PC 99 technologies and implementation.

About the Author:

Carol Jacobson is a Program Manager in Intel Corporation's Business Platforms Group. Carol is responsible for working with content owners, Microsoft Corporation, and the PC industry to develop and finalize the PC 99 guidelines.

For More Information:

To view the design guide, visit the Intel PC 99 Web site—

<http://developer.intel.com/design/desguide/>

For information on the Intel Developer's Forum, visit the IDF Web site—

<http://developer.intel.com/design/idf/>

Born to Serve: A Tale of Technologies

By Rafael Maymi
OEM Server Adapter Product Line Manager
Network Products Division, Intel Corporation

The continued proliferation of network computing across today's enterprises of all sizes has created a host of new challenges for OEMs and IHVs. Nowhere is this more true than when considering the state of ever-evolving server technology, where scalability and availability are key considerations in keeping an organization's mission-critical applications running smoothly.

Just as market segmentation is changing the contours of the desktop PC and mobile computing platforms, so today's LAN server platforms are also splintering into different segments—each with its own specific requirements. Gone are the days of “one size fits all” solutions, as network connections now must be tailored to meet the needs of each server segment. And Intel is doing its part to provide building blocks designed to enhance performance, scalability, and availability across the range of today's standard high-volume (SHV) server platforms based on Intel® Architecture.

Born to Serve: A Tale of Technologies

Intel was the first company to introduce a dedicated server adapter to the market, beginning several years ago with the Intel EtherExpress™ PRO/100 Intelligent Server Adapter—a 10/100 Megabits per second (Mbps) Ethernet solution based on the i960® processor. Since then, Intel has broadened its product offerings to meet the expanding range of needs in the server market segment, where high performance and reliability—coupled with strong management functions—are key considerations. Intel's solutions are based on a number of advanced server adapter technologies:

- **Adapter Fault Tolerance (AFT)** safeguards vital network links to the server with transparent back-up links that employ multiple adapters. AFT provides one link for transmit/receive functions and one link for redundancy across all network switches and hubs. If one link fails, network traffic is automatically—and transparently—transferred to the other network adapter, enabling the server to stay up and running to ensure high reliability and application availability.
- **Adaptive Load Balancing (ALB)** balances outgoing server traffic among as many as four similar network adapters, providing scalable bandwidth and fault tolerance. As more and more businesses begin to bring Fast Ethernet to the desktop, the need for easily scalable network bandwidth increases. ALB enables server connection bandwidth to be increased in 100-Mbps increments up to 400 Mbps. Without ALB, traffic would have to be distributed among multiple adapters by segmenting the network—a more complex and time-consuming task.
- **Fast EtherChannel (FEC)**, developed by Cisco Systems*, balances traffic load in both directions, boosting throughput for data received by and transmitted from the server. Supporting aggregated bandwidth and fault tolerance, FEC delivers scalable server connection bandwidth—in 200-Mbps increments up to 800 Mbps at full duplex.
- **PCI Hot Plug technology**, which was developed by Compaq* and is supported by Intel as part of the Compaq-Intel Networking Alliance, complements fault tolerance and load balancing by enabling a failed adapter to be replaced—“hot swapped”—without powering down the server.

An Expanding Server Adapter Product Family

Today, Intel's server adapter product family consists of three members: the Intel® EtherExpress™ PRO/100+ Server Adapter, the Intel EtherExpress PRO/100 Intelligent Server Adapter, and the Intel EtherExpress PRO/1000 Gigabit Server Adapter.

- **The Intel® EtherExpress™ PRO/100+ Server Adapter provides** a simple and cost-effective way to boost server performance, ensure highly scalable connection bandwidth and improve the availability and serviceability of network links. The PRO/100+ supports Wired for Management (WfM) v.1.1., provides automatic link-fault recovery via AFT technology, and offers server bandwidth that scales up to 800 Mbps.
- **The Intel® EtherExpress™ PRO/100 Intelligent Server Adapter** can significantly improve

performance and scale bandwidth (up to 800 Mbps) for servers operating in NetWare*, UNIX* or Windows NT* environments. In addition to employing AFT technology for superior availability, the PRO/100 Intelligent Server Adapter enables the server's host CPU to handle more transactions per second through an on-board i960 processor that offloads Interrupt Service Routines (ISRs) from the CPU.

- **The Intel® EtherExpress™ PRO/1000 Gigabit Server Adapter** provides industry-leading throughput to handle the increasing demands on campus-wide servers as Fast Ethernet migrates to the desktop. Utilizing AFT and PCI Hot Plug technology, this next-generation Intel server adapter supports the 802.3z Gigabit Ethernet standard and provides broad interoperability across the Windows NT, Novell*, and UNIX operating environments.

Intel plans to continue to introduce new members of its server adapter product family to meet the evolving needs of today's and tomorrow's server market segment. For server OEMs and IHVs, the message is clear: there are more choices to be made than ever before—and more opportunities to provide value-added solutions that provide business enterprises with outstanding server performance, scalability, and application availability as the horizons of networked computing continue to expand.

About the Author:

Rafael Maymi is Intel's OEM Server Adapter Product Line Manager. He is responsible for assisting server manufacturers in choosing the right server adapter for their designs.

For More Information:

For more Information on Intel EtherExpress PRO/100 Server Adapters be sure to check out the Server Adapter Web site—<http://www.intel.com/network/ee100server/>

Pentium® Processor Modules Enable Embedded Designs

By Robert Baraga
Staff System Engineer, Embedded Microcomputer Division
Intel Corporation

Many designers of embedded systems are aware that 32-bit processing is gaining significant momentum in applications such as telecommunications, industrial automation, and POS terminals. Intel® Pentium® processors can deliver 100 MHz plus, superscalar processing power to these applications in a convenient, highly-integrated form.

Embedded processor modules are packaged Pentium processor subsystems that provide an easy form factor for design portability and fast design-ins. Designers can tap into the Pentium processor tools and operating software base for industrial and commercial tasks, without having to become high-performance board designers.

The high-speed memory bus barrier

The good news is that Pentium processors can deliver high SPEC-mark performance. The bad news is that performance comes with a 133- or 166-MHz processor that requires a high-speed main memory backup. This higher bus-rate memory design can be challenging for designers moving from traditional 8-/16-bit controllers to Pentium processors. Power distribution, signal integrity, PCI bus and DRAM interfaces, clocking schemes and thermal issues must all be addressed, and high pin-count surface-mount devices are the norm. Fortunately, an embedded processor module can help mitigate these concerns.

Managing power distribution

Pentium processors dissipate more power than a low-end embedded controller. In addition, the power distribution network is more complicated than for earlier processors. There are two main voltages—I/O voltages that define communication with supporting chips, and the core voltage which supplies power for the main processor circuitry. I/O voltages are typically 3.3 volts or 2.5 volts (or less) in newer processors. Core voltages typically range from 1.8 volts to 3.3 volts, depending on the processor family and speed.

To provide these voltages, several regulators must be placed very close to the processor to minimize power losses and noise. The properly designed module has the regulator on-module with the capacitance storage to handle the transient requirements of the processor. The system designer now only has to provide the standard +5.0 volt and +3.3 volt power.

Modules reduce noise, increase signal integrity

High-speed microprocessors can create noise and loss of signal integrity on a single-board computer. Modules include critical chips and circuits, but they generally do not contain the full system. Given today's board and IC densities, best design practice establishes Pentium processor-based module boundaries at the processor, chipset, and L2 cache levels.

Functionally, these are the core elements of a Pentium processor system. This means that 66-MHz operation is almost completely removed from the main system board, except for RAM. Modules with a proper clock distribution, like the Intel Embedded Processor Module, will also minimize time skew—which is less than 200 ps—and line termination to eliminate signal integrity problems associated with the 66-MHz environment.

Properly designed and manufactured modules use a controlled impedance environment and strictly controlled line lengths. In many cases, the line lengths are short enough to be treated as capacitive loads. Reducing line length also minimizes crosstalk and noise and can ease compliance with EMC standards. Lower-voltage I/O components should also be concentrated on the module.

PCI and DRAM interfaces

Most modules will have either a PCI 2.1 or a DRAM external bus interface. The PCI interface connects directly to the main system board PCI bus with multiple clocks for the system. The DRAM interface

allows for 3.3 volt, 66-MHz operation. Signals are provided to allow the designer to use multiple DRAM slots with either single or double-sided SIMMs, DIMMs, or SODIMMs as the application dictates. The DRAM interface also includes data-parity for ECC functions. The Intel Embedded Processor Module uses the Intel 82439HX System Controller (TXC) because it supports ECC. Other module interface signals include resets, interrupt signals, and a voltage sense signal to determine power capability.

Many thermal design alternatives

Processor systems dissipate heat that must be removed from the board environment. Some embedded systems have fans or fan cages for cooling, while others must rely on other cooling options. Passive heat sinks work for designs with ample air flow. Active fan sinks can be used when the passive solution does not apply. Alternatives such as heat pipe solutions are available for designs that cannot use air flow.

Modules cut system validation time

Embedded processor module designs minimize system test and verification efforts for the system designer. Properly designed modules are pre-qualified and validated, with high-speed testing performed at the factory. Validation time savings can reach one month. In manufacturing, modules minimize the need for high-speed test equipment and reduce the need for expensive and time consuming test programming and debugging. Test time can be reduced by at least two to three minutes per system by eliminating extensive processor and cache testing.

Reducing system cost

High-density packaging can reduce overall system costs in many applications, especially when additional board layers are required for high pin-count components. High-speed system boards typically require up to eight layers in order to compensate for density, single integrity, power, ground and noise. Depending upon the complexity of the design, a module can reduce this number to six or, in some cases, four layers.

In addition, the use of modules avoids the need for expensive assembly equipment required by high-density, low-profile components, potentially saving costs and offering the designer greater flexibility over who assembles the system.

Next steps

Embedded designers should consider their future performance needs. Some embedded modules, like the Intel Embedded Processor Module, are fully upgradable and socket compatible. Modules allow a seamless, fast time-to-market upgrade to the existing design, without the need to redesign and re-invest. This can be a significant competitive advantage in today's fast-moving embedded market segment.

Because modules speed Pentium processor deployment, project managers should look at all development and manufacturing processes and associated costs, including time-to-market, upgradability, and ease of design before deciding how to proceed. Only when looking at the total picture can a true evaluation of the module design benefits be appreciated.

About the Author:

As a Staff System Engineer in Intel's Embedded Microcomputer Division, Bob Baraga is responsible for development of system platforms and modules for embedded products.

For More Information:

For the latest data sheets, application notes, and other information about Intel's Embedded Processor Modules, visit the Embedded Processor Module Web site—

<http://developer.intel.com/design/intarch/prodbref/971978.htm>

For information on all of Intel's embedded products, visit the Embedded Intel Architecture home page—

<http://developer.intel.com/design/intarch/index.htm>

The Intel Developer Forum in September will include detailed presentations on embedded processor modules—<http://developer.intel.com/design/idf/>

Platform News

Business

If you are an IT professional or LAN manager, join us at the Wired for Management Summit, Monday, August 3, 1998, 12:30–4:00 PM, in the Santa Clara (California) Convention Center!

Wired for Management Summit event highlights:

- Find out about Wired for Management (WfM)-based solutions that can help you to control your computing environment and reduce total cost of ownership (TCO).
- See in-depth case histories from large corporations using WfM-based solutions.
- Join in detailed Q&A sessions with other IT professionals.
- Visit the solutions showcase and see hands-on demonstrations of WfM-enabled management solutions from the world's leading computer companies.

Register on-line at <https://www.amotive.com/summit/wfmreg.html>

Intel Introduces the Pentium® II Xeon™ Processor to Achieve Unmatched Performance for Workstations and Servers

The new Intel® Pentium® II Xeon™ processor is Intel's first microprocessor designed from the outset to meet the demanding performance requirements of midrange and higher server and workstation platforms. In a word, it's FAST! The Pentium II Xeon processor was introduced June 29th at 400 MHz. If you are looking for a fast development system, look no further! For more information and an on-line, 3D tour of the new processor, see <http://developer.intel.com/design/pentiumii/xeon/tour/>

Updated Wired for Management Specifications

A release candidate draft version of the WfM Baseline specification 2.0, along with related specifications for the Preboot eXecution Environment (PXE) and Boot Integrity Services (BIS) are now available for industry review. These specifications (<http://developer.intel.com/ial/wfm/wfmspecs.htm>) are designed to reduce the total cost of ownership for business computing.

Presentations are now available from the Desktop Management Taskforce annual conference held June 2–3, 1998 at <http://www.dmtf.org/conference/schedule.html>

Home

Preview the Performance Consumer Technology Track for September IDF

Time to make plans for the Intel Developer Forum (IDF) in Palm Springs, California, September 15–17. As the PC industry's premier source of tools and training for advanced platform developers, IDF addresses solutions for desktop, workstation, server, mobile, and embedded platforms. Preview the performance consumer technology tracks at http://developer.intel.com/design/idf/tracks/trk_312.htm

Review and download Audio Modem Riser Specification AMR1.0

Intel has published the Audio Modem Riser Specification AMR1.0. This specification allows OEMs to offer the cost benefits of a modem on the motherboard, while maintaining the flexibility offered in a riser solution that minimizes modem certification requirements. <http://developer.intel.com/solutions/tech/audio.htm>

Additional information on the Katmai Processor

At the Computer Game Developers' Conference held May 4–8 in Long Beach, California, Intel provided additional information about the new Katmai processor to be introduced in 1999. The Katmai processor is designed to provide far better performance for 3D and floating-point intensive applications through the addition of 70 new instructions to the Intel® Architecture. http://developer.intel.com/drg/news/katmai_reg.htm

Mobile

Telecommunications and PC Technology Leaders Join to Deliver Enhanced Wireless Communications Solutions

On May 20, 1998 industry leaders Ericsson, IBM, Intel, Nokia and Toshiba unveiled their vision to revolutionize wireless connectivity for personal and business mobile devices. Enabling seamless voice and data transmission via wireless, short-range radio, this new technology will allow users to connect a wide range of devices easily and quickly, without the need for cables, expanding communications capabilities for mobile computers, mobile phones and other mobile devices, both in and out of the office. The open specification for this innovative technology, code-named "Bluetooth," is being developed through the combined contributions of the members of the Bluetooth Special Interest Group (SIG).

Server

A white paper from the Aberdeen Group describes Intel's Enterprise Strategy for the New Century

Intel has several important, yet seemingly disparate, technology projects underway that will position Intel Architecture (IA)-based servers as enterprise-class systems. And, many Information Systems (IS) executives are not familiar with the linkage between these technologies—and the ramifications that these technologies collectively will have on their future computer purchase strategies. In this Strategy Profile, Aberdeen articulates how these technologies fit together into a cohesive strategy that will position Intel Architecture-based servers as enterprise-grade systems as we move into the 21st century.

Intelligent Platform Management Interface (IPMI) v0.9 specifications available for industry review and contribution.

Intel, Dell, HP, and NEC invite the industry to review version 0.9 of the IPMI specification and provide feedback. IPMI version 1.0, which will include industry feedback, is anticipated to be available late Q3 '98. All feedback will be carefully tracked, evaluated, and incorporated as appropriate; however, there is no guarantee that feedback will be included in the final release of the specifications. The specifications can be downloaded from IPMI Web site at <http://developer.intel.com/design/servers/ipmi/>

Technology News

DVD

IDF Designing Platform Solutions Plugfest, South San Francisco, California, August 31–September 4, 1998

(<http://developer.intel.com/solutions/tech/plugfests/plugfest.htm>). The best opportunity to test your PC Platform Technologies with others in the industry. If your products include AGP, DVD, or Instantly Available PC/ACPI, come to this event to test with other industry leaders. Testing is scheduled in private, one-on-one sessions, without competitive pressure. During your private session, you may request non-disclosure if needed. Procedures and software for most types of testing will be supplied. Industry experts, BIOS and thermal tests will be available, along with some new test tools and a debug suite. Continue to visit <http://developer.intel.com/solutions/tech/plugfests/> for more information about our testing documents and procedures.

New DVD Technology Newsgroup Now Available

We encourage you to visit the group and submit any questions that you may have regarding DVD technology and its implementation on the PC platform. <http://support.intel.com/newsgroups/dvd.htm>

Microprocessor

Look Inside the Intel® Pentium® II Xeon™ Processor

Find out how the advanced technology of the new Pentium II Xeon processor meets the high bandwidth requirements of midrange and higher servers and workstations.

<http://developer.intel.com/design/pentiumii/tour/>

Updated Pentium® II Xeon™ Processor Design Guides and Application Notes are available now.

<http://developer.intel.com/design/PentiumII/Xeon/>

PC 99

PC 99 System Design Guide, 1.0 Now Available!

Version 1.0 of the PC 99 System Design Guide is now available. This guide is intended to advance the quality of PC hardware, firmware, and device drivers for products designed for 1999 production by encouraging PC hardware platform initiatives and technical capabilities resulting in improved user satisfaction and market segment growth. A complete copy can be downloaded from Intel's PC 99 Web site

(<http://developer.intel.com/design/desguide/>).

Platform Performance Tuning

Updated versions of Storage Toolkit, IPMAT and IBASES are shipping now

- Storage Toolkit v2.1 is now shipping. An update CD will be shipped to all registered users. Storage Toolkit v2.1 enhancements include: General problem report updates and Graphing enhancements to AnalyzeDisk and RankDisk.
- IPMAT v1.1 is now shipping. An update CD will be shipped to all registered users. IPMAT v1.1 enhancements include: General problem report updates, Support for mobile "smart" battery and Support for Windows NT* 5.0 beta.
- IBASE v1.6 is also now shipping. An update CD will be shipped to all registered users. IBASES v1.6 enhancements include: General problem report updates, Support for Windows NT 5.0 beta and OpenGL*.

For more information, please visit <http://developer.intel.com/design/ipeak/>

SSI Server System Infrastructure

- Download the latest draft Rev specifications and give us your feedback
- 0.7 of the draft specifications are posted at <http://www.ssiforum.org/>, a signed contributor agreement is now required to access draft specifications. DC to DC Converters have also been added! The SSI specification will now include DC to DC Converters for use with the single voltage output supply. Send feedback and contribution to the SSI promoters' council via <http://www.ssiforum.org>

System Design

Power delivery—VRM 8.2 DC-DC Converter Design Guidelines

VID pins will allow solutions to handle the transition from 2.8V to 2.0V. As processor frequencies rise above 350 MHz, VRM8.2 solutions will be required; those guidelines are now available from Intel at

<http://developer.intel.com/ial/sdt/v82w2.pdf>

WfM

The Windows* Hardware Instrumentation Implementation Guide now available for review

The Windows* Hardware Instrumentation Implementation Guide (WHIIG) from Intel and Microsoft documents the design requirements and recommendations for hardware developers wanting to provide custom instrumentation data using the new Windows manageability infrastructure, including WBEM and WMI. For more information, and to register as a reviewer, please see:

<http://www.microsoft.com/hwdev/desinit/wmi.htm#whiig>

Industry Events

HP World '98

August 2–8, San Diego, CA

HP strategic and tactical solutions come together at this event. Focusing on technology, connectivity, and platforms. Intel will have three speakers. For more information, please contact HP's Web site.

<http://www.hpworld.org/>

California Computer Expo

August 20–23, San Diego, CA

Enhancing the home and office through computer technology, Intel will present a paper on "Home Networking - Unleashing the Power of the Multi-PC Home."

<http://www.computoredge.com/expo/>

IDF Designing Platform Solutions Plugfest

August 31–September 4, 1998 South San Francisco, CA. The best opportunity to test your PC Platform Technologies with others in the industry. If your products include AGP, DVD, or Instantly Available PC/ACPI, come to this event to test with other industry leaders

<http://solutions/tech/plugfests/plugfest.htm>

Intel Developer Forum

September 15–17, Palm Springs, CA

Features 12 graduate level technology training tracks. Over 70 technical sessions will focus on the latest desktop, mobile, server, workstation, and embedded platform technologies with direct access to Intel's top engineers and architects.

<http://developer.intel.com/design/idf>

Power 98

October 4–7 Santa Clara, CA.

This conference brings together leading manufacturers of batteries, power supply systems, electronics components, mobile computing products, and wireless communications devices. Intel's Bob Jackson will participate on a panel on power management.

<http://www.gigaweb.com/events/>

Fall Internet World 98

October 6–8, New York, N.Y.

Conference provides opportunity to learn about Internet, Intranet, and Web applications. Intel's Gregg Adkin and Ken Stober will participate in a panel discussion on "Web TV."

<http://events.internet.com>

Next Generation Networks

November 2–6, Washington D.C.

Understanding the future trends in high performance networking. Intel's Chuck Smith, will present "New Development in Networked Collaboration," on November 4th.

Comdex Fall

November 16–20, Las Vegas, Nevada

Major show for computer industry's independent resellers of computer systems and related products.

<http://www.comdex.com>

Intel Networking Events & Training

For Intel's events and training programs on networking products and technologies, please visit the Intel networking events page.

<http://www.intel.com/network/events/index.htm>

—End of Platform Solutions Issue 11—